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Abstract

In the age of experience economy, the role of architecture shifts its focus from materiality and functionality to identity and experience. Although identity is an important factor, this thesis will focus on experience. In particular, it explores the sensory and mental qualities of architecture that are still poorly understood to this day. These qualities, however, can be revealed and reinforced with the aid of integrated media technology. The purpose of this thesis is to examine the requirements for designing technology-enhanced atmospheres in the context of architectural spaces. In order to achieve this, a case-study approach was used to help understand how integrated digital media shapes spatial experience in art installations (e.g. Olafur Eliasson) and interactive environments (e.g. Lars Spuybroek). The interactive audio-visual prototype was developed and analysed on the basis of these studies. The analysis of the prototype was supported by interviews with visitors and observations. The outcome of this thesis is the set of spatial design guidelines for designing technologically enhanced architectural environments. The results show that light and sound are some of the elements of space that produce atmosphere and affect visitors emotionally. This study indicates that the presence of interactivity and integrated technology in space can become a key driver in providing visitors with a meaningful experience. Overall, these results suggest that spatial designers and architects need to reconsider the practice of creating a spatial experience and investigate the human body with its sensory aspects as a mediator between the physical environment and the human mind.

Keywords atmosphere, spatial experience, integrated technology, interactivity

Designing technologically mediated atmospheres and experiences in architectural spaces

Thesis in Master's Degree Programme in Product and Spatial Design

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and Architecture

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06-07

Abstract

Abstract

The building is a machine able to produce some human reactions predetermined.' - Peter Zumthor (Zumthor et al., 2006).

In the age of experience economy, the role of architecture shifts its focus from materiality and functionality to identity and experience. Although identity is an important factor, this thesis will focus on experience. In particular, it explores the sensory and mental qualities of architecture that are still poorly understood to this day. These qualities, however, can be revealed and reinforced with the aid of integrated media technology. The purpose of this thesis is to examine the requirements for designing technology-enhanced atmospheres in the context of architectural spaces. In order to achieve this, a case-study approach was used to help understand how integrated digital media shapes spatial experience in art installations (e.g. Olafur Eliasson) and interactive environments (e.g. Lars Spuybroek). The interactive audio-visual prototype was developed and analysed on the basis of these studies. The analysis of the prototype was supported by interviews with visitors and observations. The outcome of this thesis is the set of spatial design guidelines for designing technologically enhanced architectural environments. The results show that light and sound are some of the elements of space that produce atmosphere and affect visitors emotionally. This study indicates that the presence of interactivity and integrated technology in space can become a key driver in providing visitors with a meaningful experience. Overall, these results suggest that spatial designers and architects need to reconsider the practice of creating a spatial experience and investigate the human body with its sensory aspects as a mediator between the physical environment and the human mind.

08-09

Introduction

It is hard not to notice the significant impact of technical mediation on every aspect of human life in today's modern society, including architecture and spatial design. There seems to be a clear trend towards connected, interactive and immersive environments. We can see it through the popularity of the Internet of Things, Augmented Reality, sensors, microcontrollers and so on. The manipulation of light, sound and materiality in architecture and spatial design has also been radically changed with the new developments of fabrication methods, computer software, lighting and audio equipment. Given this development, the role of spatial designers now includes building bridges between technology and space in order to prepare users for a new type of human-space interaction and to show all its potentials and advantages.

In this new role, spatial designers often utilise new technologies in order to explore Human-Computer Interaction (HCI) design patterns. This approach, however, does not necessarily lead to the desired results. For example, designers using HCI in order to create interactive environments find that their projects are less attractive to users and thus have lower figures (Benyon, 2014). It appears that this factor is related to two main aspects of technologically enhanced environments - interaction and experience - which are not fully understood yet.

By adopting a spatial perspective on interaction and experience, this thesis will provide new insights into designing these two elements as a whole. In particular, it investigates complex human perceptions in the context of architectural spaces. It aims to help spatial designers design better experience for ever-changing user needs. Although most of the data is processed through vision, humans measure space using all five senses. According to architect Juhani Pallasmaa, there are seven domains of sensory experience, which often interact with each other: auditive, tranquillity, olfactory, tactile, movement (Holl et al., 2006). The literature also emphasises that a current problem in architecture is constituted by the disembodied spatial experience and prevalence of the visual perception of space (Pallasmaa, 2015). As a possible solution to this problem, the present study set out to investigate the usefulness of integrated technology.

Recent literature review also shows that interest in atmospheric architecture emerged as a reaction to the tendency in modern architecture towards industrial production and geometry rather than mood and experience (Böhme, 2015). On atmospheres in spatial design, Pallasmaa (2014) also indicates that spatial experience is rarely studied in architectural and design schools. He

further states that education focuses to a greater extent on fundamental issues such as form, scale, proportions, light, while other industries and businesses are far ahead of architects and spatial designers in showing interest towards human behaviour and empathy (Borch, 2014).

Nowadays, many marketers, designers, strategists and entrepreneurs use experience design as a strategic approach for economic transformation. However, most of the industries that use this approach, bring experience that draw our attention to devices and gadgets. Thus, a large amount of experience design work nowadays is visual and produces the digital realm where we spend our energy, time and money. Spatial design can bring experience across both digital and physical realms to stay relevant in the age of digital transformation. To this point, however, there has been little discussion about experience in spatial design across digital and physical realms.

There are two primary aims of this study: 1. To explore the feasibility of shaping and managing environmental conditions with technology to produce a certain architectural atmosphere; 2. To model a guide for improving spatial experience and interactivity with the use of integrated media technology. Therefore the main research question of this work is stated as:

Q: How does integrated digital technology affect spatial experience and atmospheres in the architectural space?

10-13

Background

Architecture in experience economy

In the age of experience economy, consumer culture has changed on a global scale: people find greater satisfaction while being engaged, rather than from objects and material products. In recent years, there has been an increasing amount of literature (Pine & Gilmore, 1999; Klingmann, 2007) studying experience economy and the shift in consumer values towards differentiation, communication and customisation. Conversely, architecture is still focused to a greater extent on the values of modernism: commercial production, standardisation, simplification (Klingmann, 2007). In the same vein, Pallasmaa (2015) in his essay on mental essence of architecture, notes that the power of architecture to manipulate human behaviour and emotions is underestimated in education and practice; visual aesthetics and the utility of architecture have become more important than its mental essence (Robinson & Pallasmaa, 2015). There is a need for architecture to regain its relevance by concentration on the emotional and sensory aspect.

People understand space with their senses

The aesthetic experience of architectural spaces has been discussed in different contexts and studied in the fields of architecture, philosophy, aesthetics and cognitive sciences. Recent philosophy aims to overcome the existing western canon of aesthetics that relies on the eye as a main tool for understanding and experiencing the built environment. The literature on aesthetic experience has highlighted a strong correlation between knowing and emotions and demonstrated that emotions are tied to all our senses, such as hearing, smell, touch and taste. Bhatt (2013) argues that the aesthetic experience of architecture is a dynamic and cognitive process and that the appreciator must interact with the space and the objects in it. According to her, it is a physiological, emotional and cultural experience where our body, emotions and intellect are actively involved in perception.

With recent developments in neuroscience, it is possible to bear out these arguments. In 1963 Richard Held and Alan Hein conducted a neurological experiment with two kittens in order to demonstrate that perception relies on action and action is possible through perception (Held & Hein, n.d.). Another, more recent study, based on the enactive approach to architectural experience (Jelić et al., 2016), explored the relationship between mind, body and architectural environment through experiments with Immersive Virtual Reality setups. This study concluded that

people are not just disembodied observers of space and that the value and meaning of architectural environment emerges through the active interaction of body and space. Furthermore, following the theory of perception, the authors also suggest that architecture is experienced by providing possibility for actions (affordances). Indeed, suggestions of movement and manipulable objects in space can play an important role in engaging with and understanding the space. The paper also mentions Freedberg and Gallese's (Freedberg & Gallese, 2007) framework on aesthetic experience. According to this framework, there are three internal actions involved in the perception of architecture: emotional experience, evaluation processing and context related factors, which often interact. Considering all of this evidence, it seems that studying human perception can help designers and architects create more meaningful experiences and atmospheres in space.

Technology is slowly invading architecture

We can see this phenomenon through the popularity of the Internet of Things, Augmented Reality, sensors, microcontrollers and so on. Over the past ten years, we have been witnessing the evolution of computers. They shrink in size, consume less energy, fit more features and become cheaper. This makes it easier for them to invade into every part of our everyday activities. However, according to the author's own observation, most of the commercial deployments, the digitalisation of physical space is still in its early stage of development.

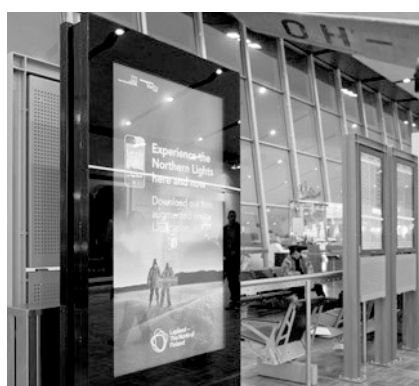
Today, according to the author's own observation while working in the field of digital design in Finland and travelling abroad, the digitalisation of physical space is present in three variations. The first stage is represented by digital signage and digital wall systems. Although the impact of the 'digital poster' is much bigger than that of a paper poster, the main disadvantage is that they do not provide the essential customer values, such as communication and customisation. The second stage involves providing interactivity and engagement. With the use of beacons, sensors and wearables, the space can offer a more memorable experience and better services. The third stage of pace digitalisation is immersion. These environments can provide visitors with a feeling of control over actions, activities and provide feedback. Technology can be installed in furniture and fixtures of space and renders the environment able to adjust or react according to visitors' mood or changes in the environment. According to this observation, it is clear that at present we are in a 'digital poster' stage of the digitalisation of space but there is a clear trend

towards immersion and new experiences.

According to the Gensler ethnographic research (Pittman et al., 2017a), approximately 71% of respondents had a greater experience in the public space with the latest technology compared to those who did not. Gensler outlines that the presence of technology in space is a key driver for a better visitor experience. Besides, the research states that people are more interested in interacting with technology in space when it is embedded in space and its fixtures rather than using it directly (e.g. through a device).

Scope

This study covers the digitalisation of space with a strong impact on user experience. Nevertheless, it does not focus on concepts such as Virtual Reality, Augmented Reality or immersion. The diagram below demonstrates the scope and focus of this thesis:



Digital signage in Vantaa airport



The interactive city screens in central Helsinki



Hito Steyerl, *Factory of the Sun*, installation (Steyerl, 2015). Photo Manuel Reinartz.



VR headset.

Low impact

High impact

Figure 1. Schematic representation of digitalisation of physical space and its impact on experience.

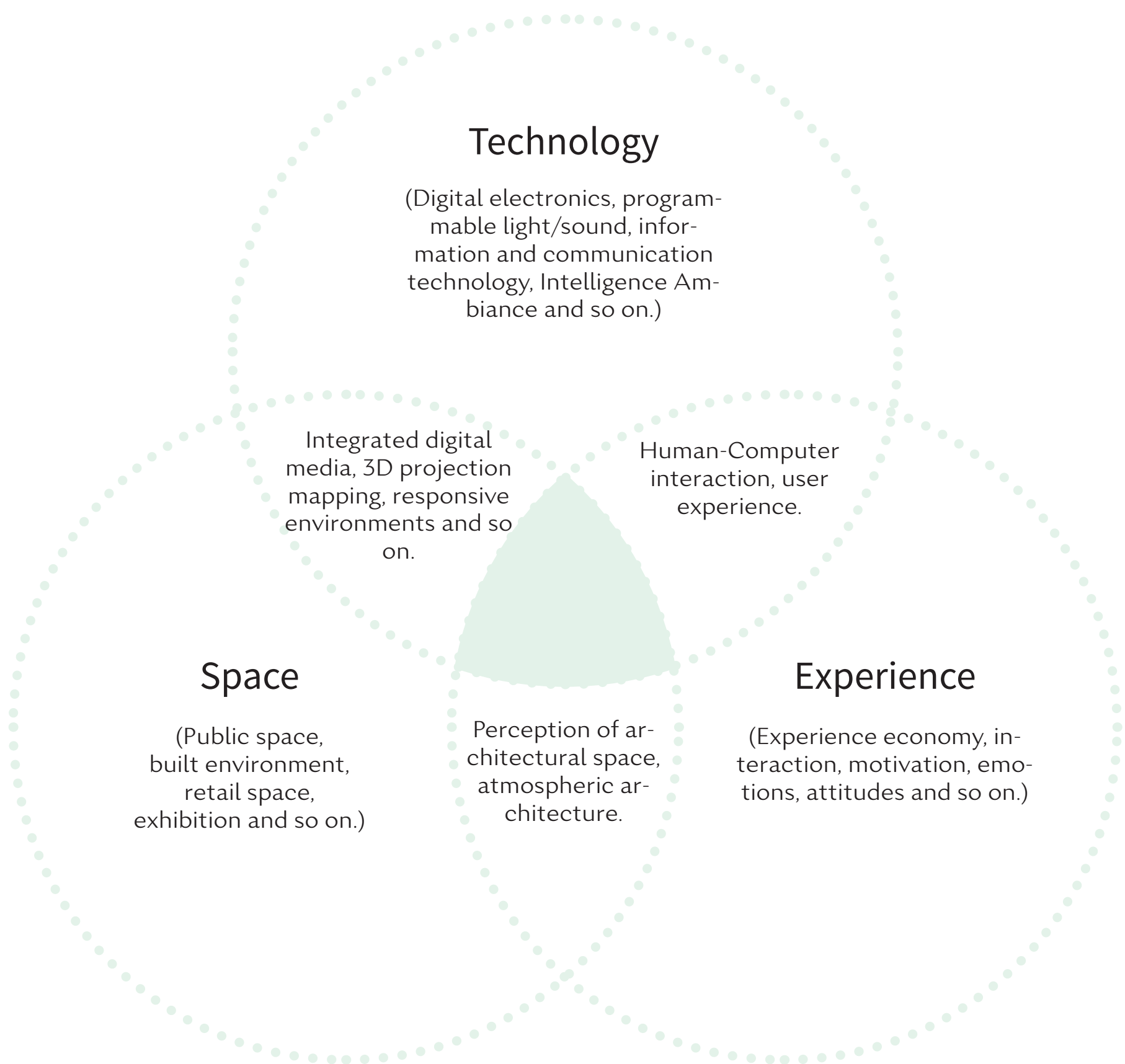


Figure 2. Scope and focus: schematic representation of the main topics discussed in this thesis.

14-15

Methods

This research will start with the careful investigation architectural theory about space, spatial experience and atmosphere in order to provide a better understanding of the scope of the project. Several publications were studied to outline the concept of atmosphere in architecture and its main characteristics. In order to define spatial experience, both phenomenological and neurophysiological theories were studied and compared. After defining the notion of architectural perception and atmosphere, an attempt will be made at investigating atmosphere in technologically enhanced environments. In order to achieve this, several examples of spatial installations (Olafur Eliasson, Bernhard Leitner) will be analysed and the impact of sound and light will be discussed. Then it will be sought to investigate the aspect of interactivity and its impact on the architectural atmosphere. On the basis of the analyses of several projects (Lars Spuybroek, Sean Ahlquist), the different use cases of the implementation of interactivity and its impact on perception will be demonstrated. In addition, the thesis will use an interactive audio-visual prototype as an example to the arguments presented in the work. Semi-structured interviews will be conducted with visitors in order to rate the experience with the prototype.

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Defining spatial experience, atmosphere and the sensorial qualities of space

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Space of physical presence

In order to start a discussion about spatial atmosphere and experience in space, there is a need to first define the concept of architectural space and how it is being formed. It can be difficult to comprehend that space can have any characteristics since in reality it designates emptiness, or more specifically, the absence of mass. However it is well-known that space is experienced by people and can provoke certain reactions, emotions or feelings once entered.

When a person enters an architectural space, he estimates his further movement in it, observing where he can and cannot go. Such reactions are described by Böhme as articulation - orientation, suggestion of movement, markings that the architect summons while designing a space (Böhme, 2006). Architects rely on the physical presence of people and make the human a point of reference and centre, creating affordances and suggestions to movement. These are the material, essential characteristics of space.

Space of bodily-feeling

However, space is not just about materiality and creating structure for our reference in the world. It can also create emotional experience and bodily-feeling. When a person enters a space, he walks around, gaining new sensations and restoring old memories and associations. According to Pallasmaa (2015), the experience of space comes with the projection of our own memories and emotions into space. We merge the sensorial experience of space with the sense of our own self (Havik et al., 2013).

In this regard, the neuroscientific approach to architectural perception (Jelić et al., 2016) suggests three cerebral networks involved in architectural experience: sensory motor, emotion-evaluation and meaning knowledge systems; where the sensory motor system measures the fundamental qualities of the environment. The emotion-evaluation system is related to the approach/avoidance behaviour, while meaning-knowledge is dependent on cultural background and individual expertise. Our sensory input and movements are key elements of how we experience space.

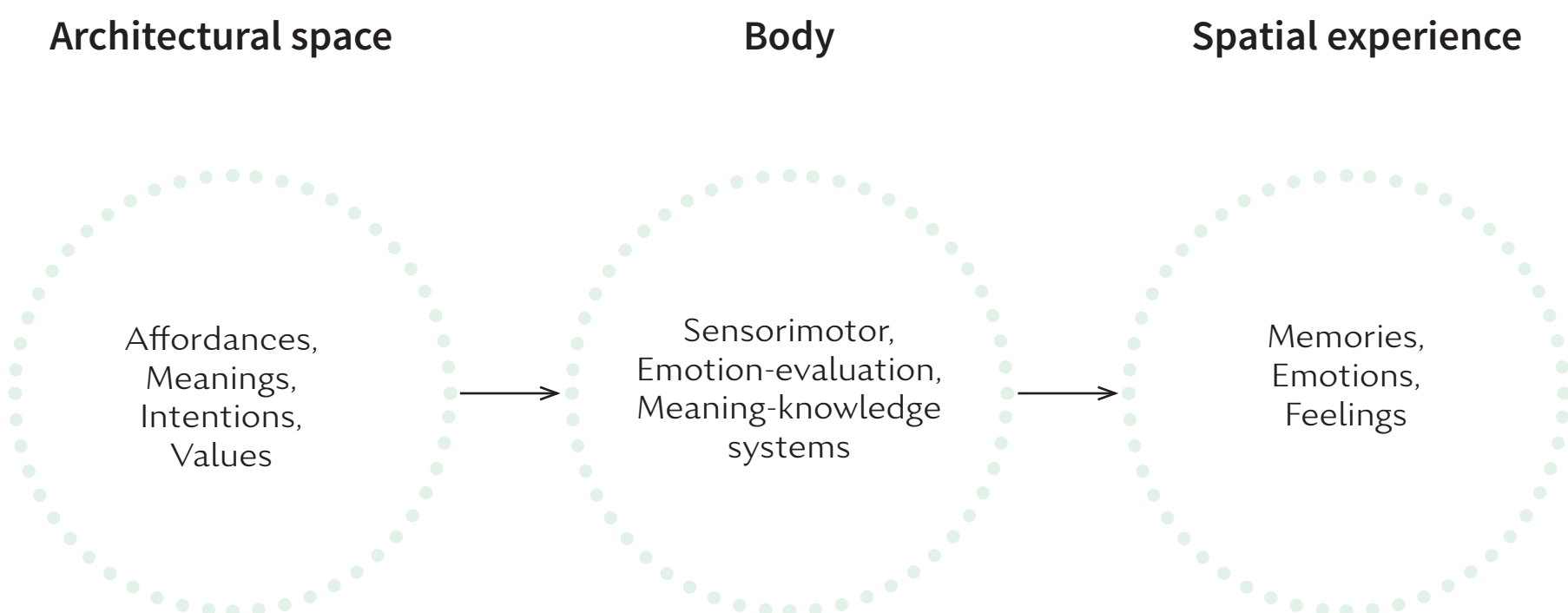


Figure 3. Schematic explanation of spatial experience. Sensory information is processed through our bodily sensations, while the emotion-evaluation system defines our motivational intentions and meaning-knowledge measures the mental content of space. These three aspects produce a subjective perspective of space in mind.

Therefore, in addition to fundamental, material characteristics, it is also important to consider the metaphorical, emotional qualities of space. These qualities are experienced through affordances and recognised by emotional responsiveness.

Structure of spatial experience

In order to be able to design a great experience, it is crucial to understand its key drivers. There is a strong connection between experience and business performance, brand, product or service and the specific design factors influencing user experience that have been explored and studied in the past. So far, however, there has been little discussion about experience in the physical space. A detailed examination of the elements of experience in the physical space by Gensler (2017) demonstrated that there are four main factors affecting human experience in the physical space: intentions, expectations, interactions and qualities of space. Although all four factors are equally important, this thesis will cover the intentions, interactions and qualities of space since the expectation factor is strongly dependent on issues such as past experience, brand and product quality, which are offal beyond the scope of this study.

“Experience modes”

In a study conducted by Gensler (2017), it was shown that visitor intentions play an important role on forming experience as people’s reasons for visitings space inform how they will understand this space. The intentions are represented by different reasons for visiting or “experience modes”. Gensler Research Institute defines five main categories: “task”(people’s prime intention is to accomplish a specific task), “social” (the main reason is to interact with other people), “discovery” (usually spending free time in between activities), “entertainment” (people visit a place to distract themselves from everyday activities) and “aspiration” (people visit a place when they are look for activities for personal growth, such as gym, landmarks, lectures). It was also noted that the same space can bring different experience, depending on visitor’s intentions. Gensler highlights that a great experience is provided by a space that can support multiple “experience modes”.

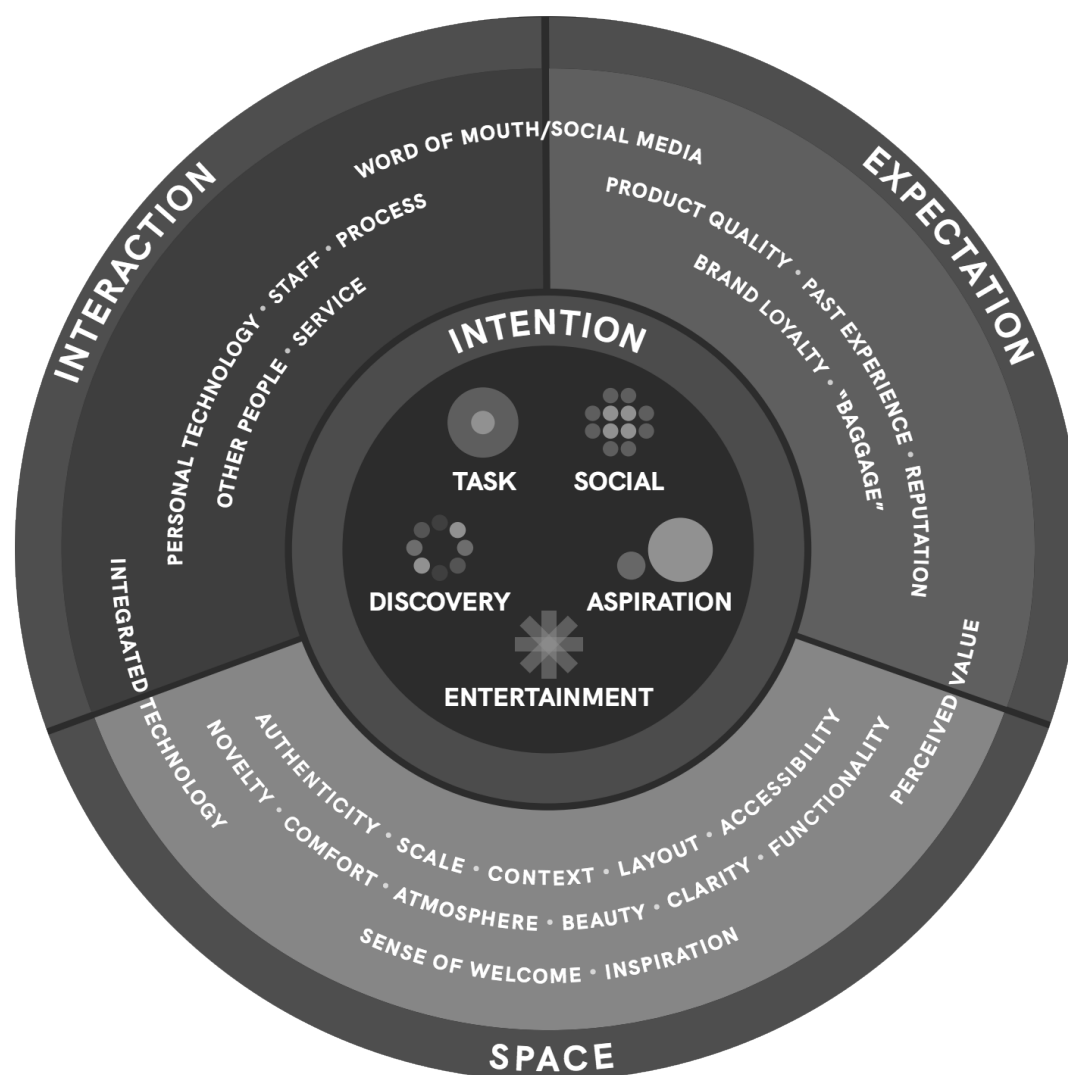


Figure 4. Experience framework, Gensler Research Institute 2017 (Pittman et al., 2017b).

On the notion of atmosphere

This section will investigate the notion of atmosphere in architecture and how different architects and theoreticians describe it. Different theories exist in the literature regarding architectural atmospheres. Hermann Schmitz, Gernot Böhme, Peter Zumthor and Juhani Pallasmaa are pioneers in the development of theory and the definition of the abstract, immaterial concept of atmosphere.

In order to answer the question why certain architectural environments provoke certain feelings in people while some do not, Peter Zumthor (2006) suggests looking for an answer in the concept of atmospheres. According to him, it covers two abstractions:

- Emotional response, how we perceive spaces
- Sensorial qualities, bodily feeling

Gernot Böhme (Borch, 2014) emphasised the strong connection between emotions and space: 'they are spaces with a mood, or emotionally felt spaces'. He defines them as 'entities' that can exist outside in the space and not necessarily inside your mind. He referred to atmosphere as both a spatial and emotional concept: 'a kind of spatially extended feeling' (Pallasmaa et al., 2015).

Juhani Pallasmaa (Borch, 2014) highlights that atmosphere defines the quality of architecture: 'when the ambience of a space fuses and heightens the sensory experience.' He makes two statements about atmospheres:

- They are experienced emotionally first and then intellectually. People experience the overall character of space before they start to analyse its essential features.
- Architects and designers should concentrate more on the quality of the multisensory experience of space and atmosphere. It defines the character and quality of space.

Atmospheres as a subtle form of power

G. Böhme (2006) has argued for exploring not just the notion of atmosphere but also learning how to design and produce atmospheres intentionally. In the book 'Architectural atmospheres:

on the experience and politics of architecture' (Borch, 2014), the author claims that architectural atmosphere can act as a 'subtle form of power', which controls human behaviour and experiences. Therefore with this 'power' designers, placemakers, brands and artists are able to establish certain associations, and provoke memories, feelings and emotions for their customers and visitors. It can be achieved by studying the ways of construction of atmospheres and learning the methods of their implementation.

On the multisensory perception of space

Spatial perception is multisensory: we process a lot of information through our vision, what we hear is a significant part of what we think we know. Pallasmaa (2012) suggests that space is equally measured with our bodies mainly by eye, nose, ear, tongue and skin. Thus, while designing and manipulating the immaterial qualities of space, such as visual, olfactory, auditory, and tactile, it could be possible to intentionally create meanings and provoke different feelings, such as rejection or invitation, brutality or amenity, overwhelmingness or intimacy.

Furthermore, as noted by Alan Held and Richard Hei (Held & Hein, n.d.), the perception of the architectural space relies on action and movement and action is only possible through perception. Perception also involves a body schema. According to Merleau-Ponty (1996), who studied the human body and the world as it is perceived, the body schema is the bridge between the body and the perceived world, which only emerges through living activity and cannot be specified in advance. He emphasises the strong connection between the body schema and the movement that crosses the body and the world. The classical neurological experiment on visual perception and the movement conducted by Richard Held and Alan Hein (Held & Hein, n.d.) in the 1960s demonstrated that these two faculties - action and perception - are inseparable and depend on each other. Our movement in space gives the dimension of depth of the visual perception. Movement is key to understanding the visual sensation.

Thus, atmosphere in architecture can be described as the metaphorical qualities of the environment that stimulate an immediate emotional reaction. It is a certain character of space that highlights its fundamental qualities and that can be only grasped while engaging with the space. It is atmospheric 'affordances' that invite meanings, emotions and feelings.

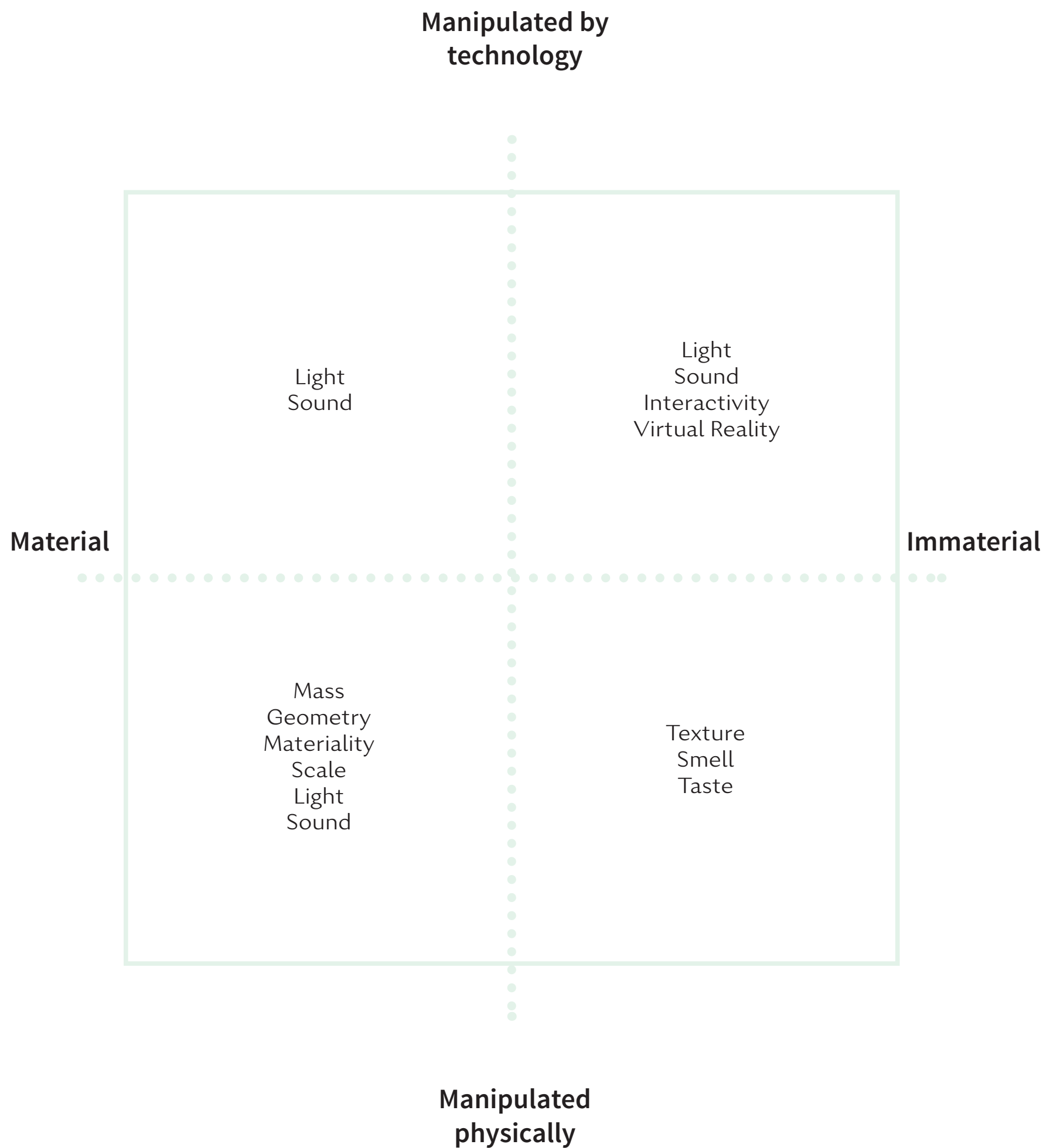


Figure 5. Material and immaterial qualities of space. Examples of material mediums that could be manipulated to design space in comparison to immaterial, additional mediums that are used to enhance the sensorial quality of space. There are also examples of mediums that could be simulated only physically in comparison to the ones which are created with the help of technology.

Material and immaterial qualities of space

Taken together, the studies presented thus far indicate that the elements of space could be divided into material, essential elements, without which space cannot be constructed, and immaterial, non-fundamental, additional qualities that enhance spatial experience. This section will focus on how the atmospheric experience is shaped by the material and immaterial qualities of space.

Mass and space

Mass and space are raw materials, which are fundamental for creating architectural form. An architect expresses certain concepts and experiences by organising mass and space into a composition with its individual proportions and rhythms. This way, the architect communicates these concepts to the user, and the user is able to experience the character of space: either static or dynamic, closed or open, uniform or complex. While in order to experience a certain mood, serene or overwhelming, gloomy or bizarre, the architect must be able to predict or control immaterial, ephemeral environmental settings.

Light and sound

Light and sound can be shaped by both technical and physical means. The architect can control the interior light in a building by selecting the position of its source, direction and amount of light in the space. Böhme (2006) has stressed that light and sound can create space. He suggests that with the technical production of light and sound and its management, it is possible to give space a certain character. However, he points out that it is important not to confuse architecture with stage design: 'Life is serious, art serene'. Thus, he highlights that the main task of architecture is designing space with the purpose of experiencing it, not just observing it.

Movement and interaction

Spatial experience is not only an observation; it is a dynamic sensorimotor activity. Space should be measured by approaching, movement, walking around and touching. Unlike works of art, space requires an active exploration. As a person enters a space, his body measures the scale, proportions, he follows the suggestions to movements. In a study investigating sensory experience, O'Regan and Noë (2001) reported that we engage not only our sensory but also our motor

contingencies (O'Regan et al., 2001).

Our kinaesthetic sense appears to be an important part in the context of spatial experience mediated by technology. It has been argued that emerging technologies, such as motion, gesture recognition can communicate between the physical and digital domains and can be a relevant tool to enable a more personal and customisable experience in the architectural space (Sama, 2011).

A clear illustration of the atmospheric experience in space can be found in the Pantheon in Rome. It shows how the architect's intentions are achieved through a co-dependency of the emotional experience and material qualities of space. The user experience is structured in a specific manner: a person starts from a narrow dark entrance that limits the possibility of actions and suggests a rather gloomy mood. Then the central space opens up thus making the person change his posture and look up and measure the difference in light and scale, which generates an immediate emotional reaction in his mind, accompanied by a feeling of dignity and tranquillity. The Pantheon is an example of a well-designed space that is based on the distinct intentions of creating a certain atmosphere. In order to produce this atmosphere, the architect manipulates fundamental means of creating space, such as natural light, geometry, materiality and scale.



Figure 6. Atmospheric experience in architecture with the use of fundamental means of creating space: mass, light, scale, geometry.

Creating atmosphere in space

G. Böhme encourages addressing the principles of stage design while designing a certain character for a space. According to him, stage design ‘is the art of producing atmospheres’ (Pallasmaa et al., 2015). The process of producing atmospheres is also discussed in a recent paper written by D. Charitos and I. Theona on the atmosphere of pervasive and ubiquitous computing mediated spatial experiences. In this paper, the ideas of Böhme related to manipulating environmental conditions to generate atmosphere are strongly supported. This paper also investigates the process of producing atmosphere by establishing conditions with the use of material artefacts and ubiquitous computing technology that act as generators (Charitos & Theona, 2016).

Together, these studies indicate that creating an atmosphere is manipulating a composition of material conditions and artefacts (such as light, sound or interactivity) that will allow an emergence of atmosphere in the space.

anticipate the future feelings of visitors. Firstly, it is sought to begin from the perspective of user, rather than geometry; secondly, it is necessary to be aware of details; lastly, it is necessary to focus on bodily feelings rather than space. Italian philosopher Tonino Griffero said: ‘planning atmospheres is an exercise of empathy’ (Pallasmaa et al., 2015). The process of creating atmospheres requires a strong imagination since designers have to predict what kind of emotions and associations the user will feel in space and what bodily sensations it will stimulate. In view of all that has been mentioned so far, one may suppose that meaningful experience is strongly dependent on empathy, compassion and the amount of shared understanding between the designer and the user.

Besides the main purpose of architecture being utilitarian, it materialises concepts, values, and metaphors and enables structure for human occupation. The material qualities of architecture become meaningless without the physical presence of humans. This is why it is essential to understand the ways people perceive the architectural environment. Understanding the structure of embodied experience in architecture enables architects and designers to create more meaningful experience in space.

Creating meaning through atmosphere

Meaning emerges from the interaction between spatial experience and the conceptual processes, which create and organise this experience in meaningful ways (Durão, 2009). With the power of atmosphere to create mood and emotions in space, there is a potential to communicate values, concepts and metaphors. Kate O’Neill (O’Neill, 2016) compares creating meaning with the communication process. She considers three aspects of communication: speaker intent, the message itself and listener takeaway. In her analyses of meaning creation, she proposes to consider creating meaning as creating a shared understanding between the designer and user.

Pallasmaa (2013) believes that atmospheric experience emerges from the ability of the designer to feel and understand the nature of human behaviour. He further states that if the material qualities of space suggest movement, the atmosphere suggests emotions, which are bound to the former experience of the user and release certain deep memories (Havik et al., 2013). Almost every paper that has been written on atmospheres and spatial experience includes a section related to empathy. Similarly, Böhme (2015) argues that the designer should strive to

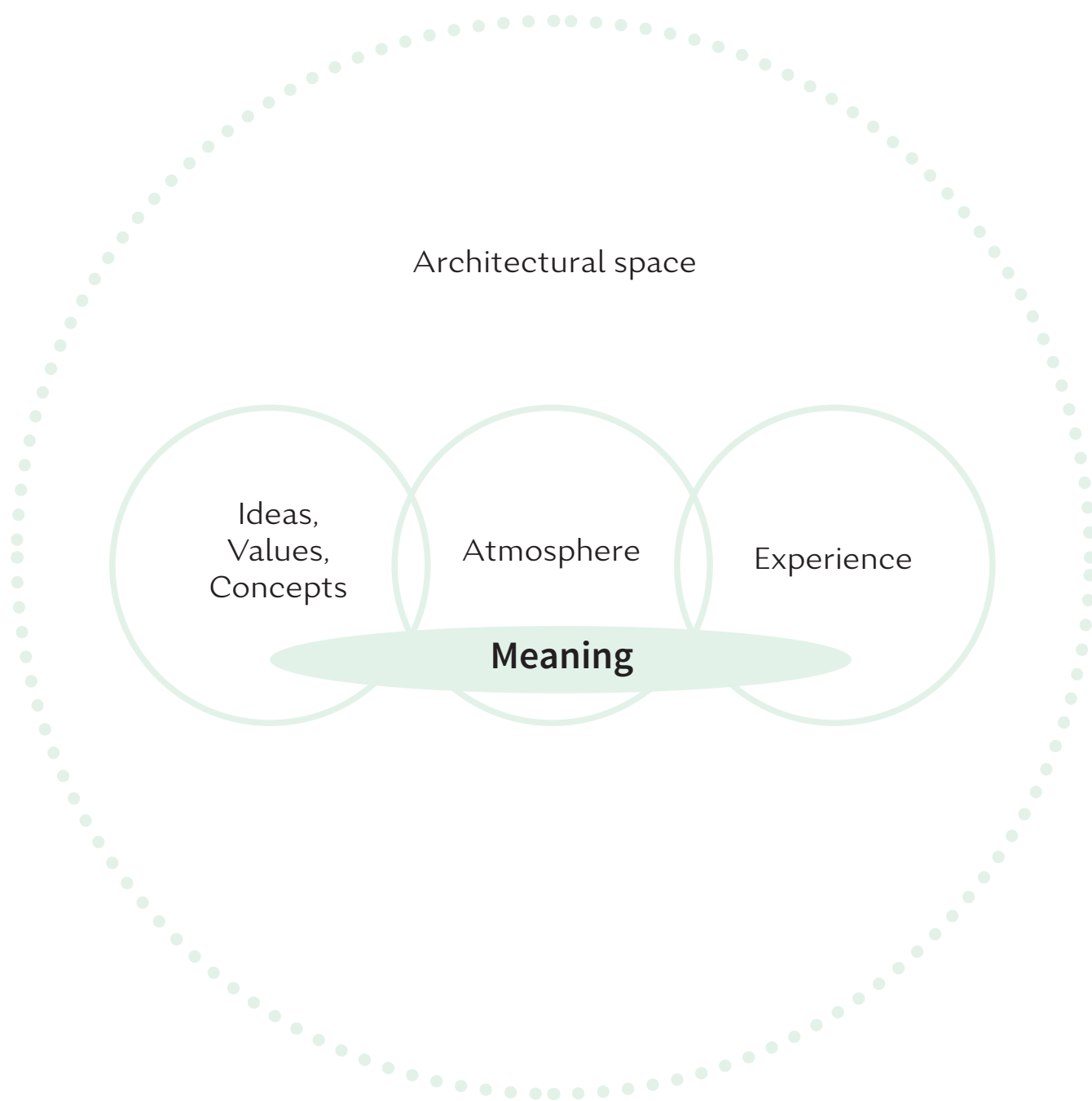


Figure 7. Creating meaning through atmosphere in space

24-27

Atmosphere in technologically-mediated spaces

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On the mental essence of space

25-26

Light and color

26-27

Sound

On the mental essence of space

'Architecture is constructed mental space' - Keijo Petäjä, Finnish architect (Robinson & Pallasmaa, 2015).

The power of architecture to influence our consciousness is underestimated. People are used to evaluating the architectural environment by its visual characteristics but rarely by its sensorial and mental qualities. In fact, as any other work of art, architecture impacts us emotionally before we start to understand it intellectually. The mental content of space is what we generate in our minds and it is not represented by the material qualities of space or objects.

The immersive audio-visual installation by Ryoji Ikeda 'The Transfinite' (Ikeda, 2011) is an example of how atmosphere can be produced with the aid of technology. The installation articulated the scale and dimensionality of the Park Avenue Armory's vast space. 'The Transfinite' included a tall projection wall that occupied the full free span space of architecture. The dynamic projection on the wall and floor was dynamic, constituted by flickering black and white patterns which in fact represented small scale mathematical information (graphs, numbers, and words). The soundscape of the installation was ambient electronic music characterised by aggressively percussive, buzzing and whistling features, rather than disturbing sounds. During the exhibition, visitors were allowed to take off their shoes and walk on the floor covered by soft fabric (Johnson, 2011).

According to the artistic director of the Center for the Art of Performance at UCLA, Kirsty Edmunds (2013), when people walked in, they first tried to negotiate an enormity of space, then they would change their position towards the projected floor where they start to behave differently: some of them would lay down, some would stand, some would approach the projection wall to discover the details of the pattern. In her review of the artwork, she concludes that people felt something pure and elegant through the installation and were enjoying its sensational effects (Forma, 2013). Overall, this example demonstrates spatial structure as a direct expression of the artist's intention to create a certain atmosphere in the space. The artist uses technology to manipulate the environmental settings: emphasises the scale of the built environment, adjusts the light and sound. These settings facilitate the emergence of atmosphere in the space. Ryoji Ikeda also uses technological-

ly-mediated sensory cues to establish certain associations for visitors. The abstraction of the visuals together with the non-idiomatic soundscape have an emotional impact on visitors; it triggers their imagination and memory and generates the mental content of the space in their minds. The mid-90s glitch aesthetics factor is the shared understanding between artists and visitors that makes this installation meaningful for most people of a certain age. Thus, creative technology was used to create a certain atmosphere in the space and to intentionally design embodied, emotional and cultural visitor experience. It also demonstrates that the aesthetic experience in the public space is a cognitive and dynamic process and that visitors' physical emotions and intelligence are actively involved in perception.



Figure 8. The Transfinite, by Ryoji Ikeda, photo: James Ewing, courtesy of Forma, Ryoji Ikeda website.

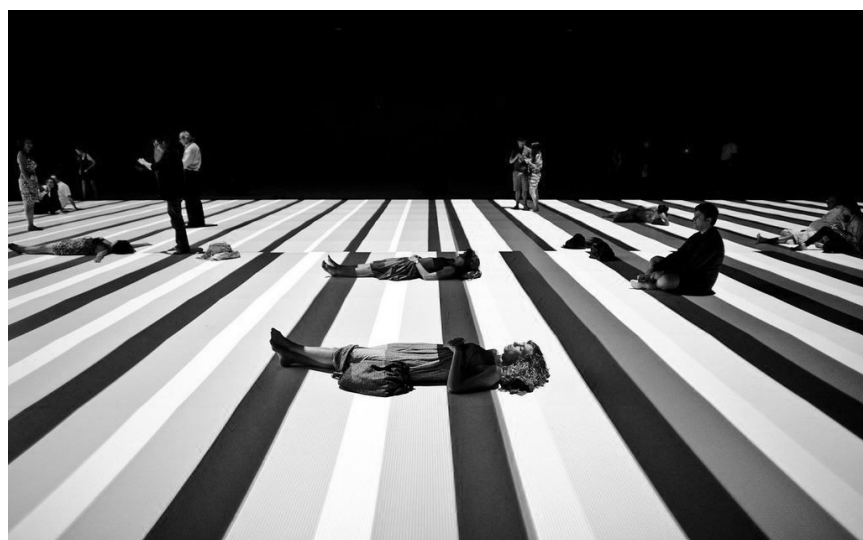


Figure 9. The Transfinite, Ryoji Ikeda, by Reeve Jolliffe, Flickr, used under CC Attribution 2.0 Generic Licence.

Light and color

Light is one of the mediums that has a great potential to shape an atmosphere in space and it can be easily manipulated by technology. In recent years, developments in the technologies of illumination increased in number and designers need to be constantly updated about recent

achievements in engineering. Although exploring new developments in technology is important, designers should be able to understand the perceptual qualities of light. One of the artists who actively use this opportunity is Danish-Icelandic artist Olafur Eliasson. He explores the nature of perception when creating his large-scale spatial artworks. One of his works *'The Weather Project'* (Eliasson 16 October 2003 - 21 March 2004) exhibited in 2003 in Tate Modern explores the artistic and scientific characteristics of light and colour. The artwork represented an installation that included a giant composition of about 200 yellow mono-frequency lamps, mirror foil and haze machines. According to Marcella Beccaria, Chief Curator at Castello di Rivoli Museo d'Arte Contemporanea in Italy, the visitor experience starts with entering the long and tall Turbine Hall, then, as people walk towards the end of the space, they would go through a range of atmospheric experiences. When they would reach the end of the hall they discovered the simplicity of the composition (Beccaria, 2013). The light and colour in this installation transform the audience's experience of the space. The mirror surface in the ceiling was placed in order to make people see themselves and enhance the sense of presence. Thus, the artist intentionally enhances the sensory experience in space.

Nevertheless, technologically enhanced spatial installations do not create space or an atmosphere. They act as a subtle intervention in the existing environment that generate an atmosphere. The challenge for the artist or designer is to render this intervention of technology natural and emphasise the existing atmosphere in the built environment. The existing atmosphere of *Silo 468* (Collective, 2012) in Helsinki with its prevailing winds and seaside location served as an inspiration for the Lighting Design Collective team, who created a unique lighting project for this space. The light installation uses the artificial lighting concept in order to emphasise the existing atmosphere of the space. This installation includes a custom-made software application that uses swarm intelligence and nature simulating algorithms; this algorithm is updated by responding to parameters, such as wind speed, direction and temperature (LDC, 2013). Hence, the light patterns are smooth, natural and never repeated; they serve as an accompaniment to the existing soundscape of wind, sea and birds. This example shows how lighting can be constructed with the use of data projection to produce a specific atmosphere in space. Constantly changing environmental settings (light pattern, the sound of wind and sea) immerse visitors in the atmosphere shaped by both nature and technology.

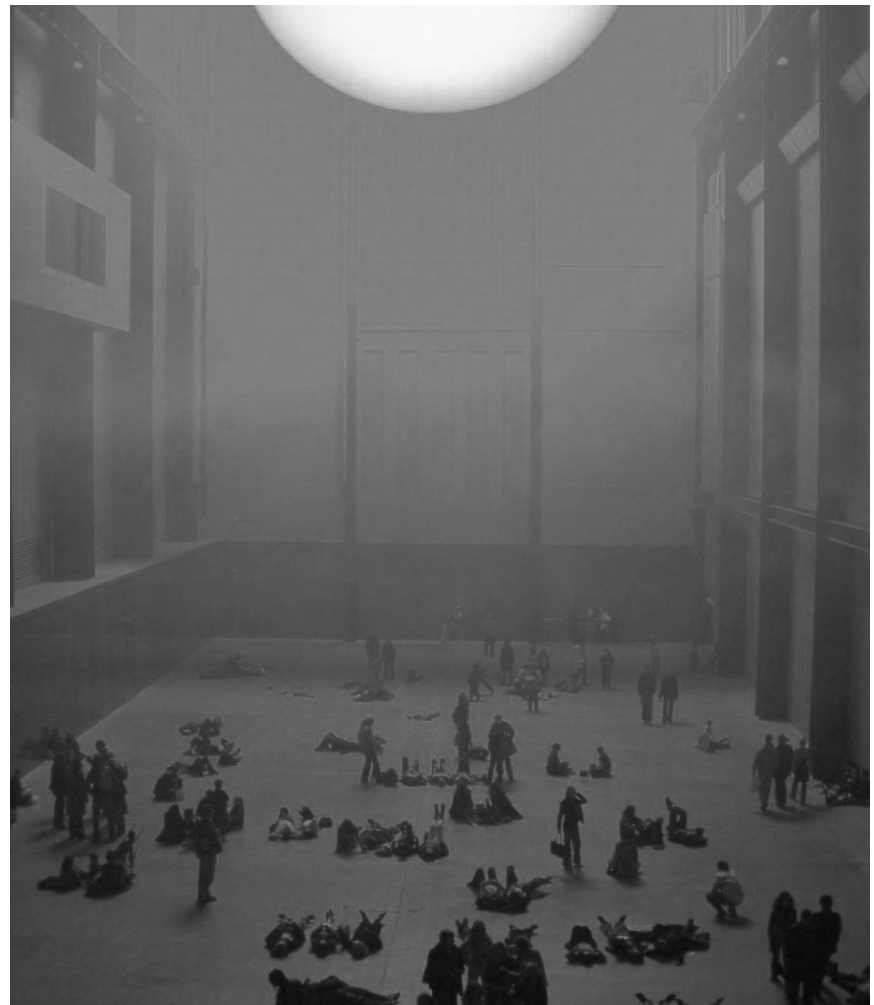


Figure 10. *'The Weather Project'*, by Olafur Eliasson, Turbine Hall, Tate Modern



Figure 11. *Silo 468*, by Lighting Design Collective, Helsinki. Silo 468 became a highly-used public attraction for the citizens of Helsinki.

Sound

'Sound is invisible but has the power to change the space characteristics we occupy' - Julia Schulz-Dornburg (2000).

Although we perceive most of our surroundings through our vision, there is a need to define sound as a sculptural medium of an atmosphere. Hearing is an important part of perception of space: it enables us to understand the depth,

scale and materiality of the environment around us. However, the sound aspect is often ignored in the field of architecture and design since it is being considered as too technical and unrelated. To be able to learn how to manipulate and control sounds, there is a need to consider the tangible, architectural qualities of sound. In fact, sound consists in moving waves of air and hearing is our response to the frequency of these waves. While the perception of sound is a process of a physical medium being sensed by our ear and converted into electrical impulses. The wavelike behaviour of sound in space suggests that it is a three dimensional spatial composition of moving air that is being perceived by our bodies.

The existing literature on sound as a spatial medium is extensive and particularly focuses on Austrian artist, author and university professor, Bernhard Leitner, who is considered as one of the pioneers of sound installation art. He has been studying the relationship between architecture, body and sound since the late 1960s. He believed that sound is a sculptural and spatial medium that allows space to emerge (Lopez, 2011). His artworks and installations are the result of long research on the frequencies, volumes and motions of acoustics, its influence on the body, as well as the impact of bodily posture on auditory perception.

Sound installations are de facto empty spaces and they are meant to shift the visitor attention from the visual qualities of space and objects to the acoustic ones. When the visitor can no longer evaluate objects and visual distractions, he can feel the sound that fills the entire space. Accordingly, sound can best serve as a sign of complete space to such an extent that it enables the viewer to develop the sense of becoming part of the whole space. The installation space evokes an embodied experience which takes place in the conscious awareness of being surrounded by intentionally designed environmental settings.

If the task of sound and tone production is left to audio technicians and engineers, the control of the acoustic field of space is the task of a spatial designer. By analysing Leitner's works, several approaches to shaping architectural experience with sound could be defined. Firstly, it is important to consider the positioning of resonant objects in space, their shape, size and materiality. In this process, the spatial designer is able to design the movements of sound. Secondly, visitors' posture and position must be considered or designed intentionally. The most significant difference between Leitner's space of installation and stage design is that the listener becomes a visitor. Stage design suggests a fixed position of

the listener since the sound is produced on the stage, while in architecture the visitor becomes an active participant who interacts with the space. This is achieved by designing suggestions of movement, affordances and composition of resonant objects, keeping the visitor in mind.



Figure 12. *Pendulum Platform 2*, Atelier Leitner 1995.

Helsinki Airport has been experimenting with the soundscape in the terminal 2 check-in and security control areas. The purpose is to generate a calm atmosphere and a relaxing experience for visitors with the blend of natural sounds like birdsong or flowing water. The installation consists of software that constantly generates new sound combinations, Soundweb processor and 16 relatively small speakers. The processor is connected to a microphone that collects the data about ambient noise in the space and adjusts the volume appropriately. The speakers are mounted into the ceiling in a grid pattern in order to spread the flow across the environment, which makes it impossible for visitors to understand where exactly the sound comes from. On their website, Finnavia shares the feedback from passengers, which is highly appreciated (www.finnavia.fi 2016).

Light and sound are ephemeral though critical elements in space-making that enhance the fundamental qualities of space. They can be used to define, create and manipulate an atmosphere and perception in space but not just for decoration purposes. Light and sound can be recognised as materials in spatial design, and can be intentionally shaped to communicate an identity of space.

28-30

Interactivity

The neurological experiments conducted by Richard Held and Alan Hein (Held & Hein, n.d.) proved that the perception of the architectural space relies on action and action is only possible through perception. However, architects and designers are not trained to design movements and actions before designing the shape and image of environments. This section will discuss the hybridisation of space with technical media in enabling active human-space interaction.

A notable example of the hybridisation of space with technical media to enable active user participation is the 'H2Oexpo' water pavilion (1993-1997), designed by Dutch architect Lars Spuybroek. It is a fully interactive building where visitors can transform the light and sound of the environment with a wide range of sensors. Unlike in a classical exposition, where seeing and moving is straightforward, in the water pavilion, images and sound appear according to the activity of the visitors. It responds locally and as a whole and consists of several interactive systems connected to each other: wire-frame projections, light movement and sound. While visitors pass through the building, they can see real-time generated water effects such as ripples, blobs or waves. In addition to technical media, Lars Spuybroek uses actual water effects such as small springs and spraying water. He also intentionally designs topological vagueness, lack of articulation in the interior to create larger potential to movement without certain predefined actions (Spuybroek, 2004).

Even though this project is relatively old, it demonstrates how customised experience, differentiation, active participation of visitors and a unique atmosphere are achieved with the use of integrated technology. These values were achieved through investigating complex human perceptions and actions. While describing this project in his book 'NOX machining architecture', Lars Spuybroek (2004) discusses about his interest in neurophilosophy and that during the process of designing the water pavilion project, he realised that questions of posture, perceptions and activity were architectural questions. The interest in human perception and researching the relationship between art, architecture and computing exerted a significant impact on many other innovative projects of Lars Spuybroek.

Using integrated technology to improve interaction while keeping in mind human perception is an effective way to engage all the senses and create richer experience. Besides creating a pleasant and diverse experience, interactivity in space can support different use cases. 'StretchPLAY' is a good illustration of how interactivity in space can be used as form of therapy.



Figure 13. *H2Oexpo*, Neeltje Jans, the Netherlands. 1993-1997. Lars Spuybroek fonds, CCA Collection.

'StretchPLAY' is a prototype that was designed within the framework of the research conducted in the Taubman College of Architecture and Urban Planning at the University of Michigan. This research aims to create a hybrid textile system, providing an interactive environment and behaviourally-regulated experience for children suffering from the autism spectrum disorder. The prototype included a tent-like tensile structure that is responsive to touch and was developed in order to visually demonstrate the connection between motor skills and visual and auditory response. This helps children to appropriately regulate the amount of force to a certain movement - the common challenge for people with autism (Ahlquist et al., 2017).

'StretchPLAY' was also designed in order to enable collaborative play by means of multi-sensory engagement. The large-scale textile environment reacts to a tactile input with a range of visual and auditory feedback. The output includes projections and sounds triggered by a single or multiple activation points. Users are encouraged to press the set of matching triggers at the same time (Ahlquist et al., 2017). This example demonstrates how creating technologically mediated responsive environments with enhanced human-space interaction could be a powerful therapeutic tool.

Interactivity can be a good tool to encourage designers to shift their focus from the visual qualities of space to experience and perception, turning geometry into surfaces of action and interaction and adding poetic layers and narratives. Although human-space interactions in architecture are usually designed through affordances and suggestions to movement, integrated technology can articulate an existing physical structure. Physical space can obtain a certain character, it can respond or adapt to human behaviour. Overall, these cases support the view

that technologically mediated interactivity can support different contexts and user needs; it has the potential to express the mental content of space and communicate a narrative. Therefore, developing sensation-rich environments that encourage interaction with different ambiances can help architecture regain its social relevance in the age of experience.



Figure 14. Prototype for technology-embedded “play-scape” *StretchPLAY*, a large-scale interactive 3d structure for collaborative play. 2016. Sean Ahlquist, University of Michigan Taubman College

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Prototype

34-36

Design

37-39

Evaluation

39-40

Results



Figure 16. Visitor interacting with the prototype in the Amos Anderson museum. Photo: Daniel Morales.

'Create the formula' is an interactive audio-visual installation designed for Helsinki Fashion Week by digital consultancy agency Futurice. It was developed by a small team in Futurice and was first presented to the public during the Helsinki Fashion Week event in July 2017. The design was mainly developed by the author under the supervision of service designer Annina Antinranta, project manager Noora Ahmed-Moshe and with a help of volunteers from Futurice. The software was created by developer Heikki Heskainen and the sound was designed by Tuomas Ahva in Futurice. The installation features projector, speakers, software and projection canvases. This project was designed within the research framework and sought to be not only a work of art but also a measuring tool to support the arguments mentioned in this thesis. This study includes the evaluation of the design and interactivity of the installation and demonstrates how the integrated technology can contribute to the atmosphere of the architectural space.

Design

Helsinki Fashion Week (HFW), managed by the Nordic Fashion Week Group, is a non-profit organisation that focuses on a sustainable future. The program consists of 100 % sustainable local and international products and brands. The aim of the organisation is to educate the Finnish consumers and local companies in international fashion culture. According to the HFW, their main goal and core value of the event is sustainability. The organisation introduces brands that share the values and provide alternatives to the consumers. The HFW event includes showcases of collections, fashion shows and installations as well as fashion performances and presentations (Antinranta, 2017). Futurice Oy is a Finnish digital consultancy agency providing digital services for its customers (Futurice, 2017). Futurice has been sponsoring HFW in 2016 and 2017 by adding digital experience into the architectural space of one of the event locations. The main goals of this sponsorship are marketing as well as participation in educating consumers to understand their impact on nature and help them make sustainable choices. There was also a strong feeling that Futurice needs a universal concept, a system that could be reused for other public events such as Helsinki Fashion Week. It has to meet certain requirements, such as portability, easy installation and it should also be able to support multiple brands as well as the Futurice's own brand.

Space

In 2017, Helsinki Fashion Week took place in the Amos Anderson museum in Helsinki city centre and lasted 4 days. The space for the installation was provided in the attic of the museum. The building was built in 1913 and the museum opened the doors to visitors in 1965. It has 4 floors and an attic which used to serve as Anderson's private living quarters and office space for his businesses. The collection is mainly 20th century art although some of the pieces of Amos Anderson's collection are also exhibited in the museum (Museo n.d.). During Helsinki Fashion Week the entire building was open for both HFW participants and museum visitors. The primary activities at the event were fashion shows that took place on 1-4 floors of the building, while the attic was not engaged in any of the activities. The attic showcased the collection of contemporary art 'Generation 17' that was on display in Amos Anderson during that time. The idea was to create a space where people can go to unplug and escape, to spend the 'in-between' time while waiting for a fashion show. According to the Gensler research, people are most likely to discover new experiences while taking their time to unplug. About 70% of respondents who took time to unplug and visited public spaces without an intended purpose had a greater experience than the ones who did not (Pittman et al., 2017a).

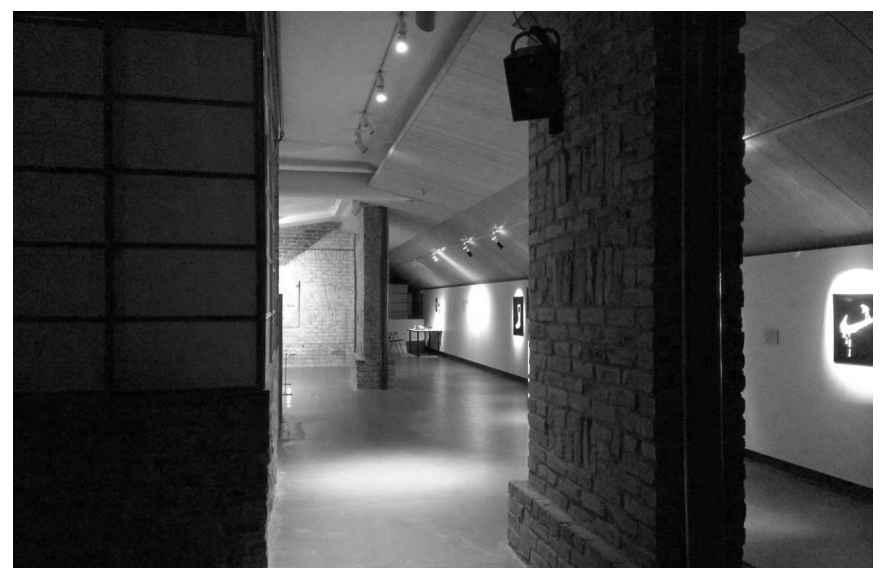


Figure 17. Amos Anderson Art Museum's attic before the event.

Spatial narrative

In order to create or manipulate visitors' relationship with space, there was a strong need to interpret the subjective qualities of space from the visitor's perspective. For example, in the service or product design fields customer journey is commonly used to describe the details and nuances related to the subjective qualities of services or products. In contrast to the service or product experience, spatial experience has its own components that cannot be mapped using a standard customer journey template. Spatial experience is multisensory and therefore visitors' posture, senses, position and movement should also be designed and outlined on the map. Thus, it was decided to use the 'spatial narrative' - an analogue of both customer journey and storyboard. It combines elements from customer journey, such as channels, timeline and emotions and elements from the storyboard such as keyframes, or the description of sound and lighting.

The purpose of the spatial narrative in this project was to tell the story about the space to the team and to address possible ways of how people can behave and interact. It was also an essential part of the design process since it helped visualise the abstract and ephemeral components of spatial design. Spatial narrative included elements such as storyboards, sketches, keyframes, text or oral descriptions. The elements of the spatial narrative were also used to design the way in which visitors interact with spatial installations. Therefore, the interaction was divided into five phases: awareness, discovery, engagement and post-interaction.

Storytelling has the potential to express the vaguely definable and hardly identifiable character of an atmospheric sensation. The aim of the installation was to create a certain atmosphere in the space in order to deliver the artistic message of the installation. There was a plan to make a shift from a gloomy, more neutral atmosphere to a more tense or dramatic one while people interact with the installation. Thus, in order to be able to design the triggers (sound, light, and colour) that can evoke such an atmosphere, oral/text descriptions and sketches were efficiently used.

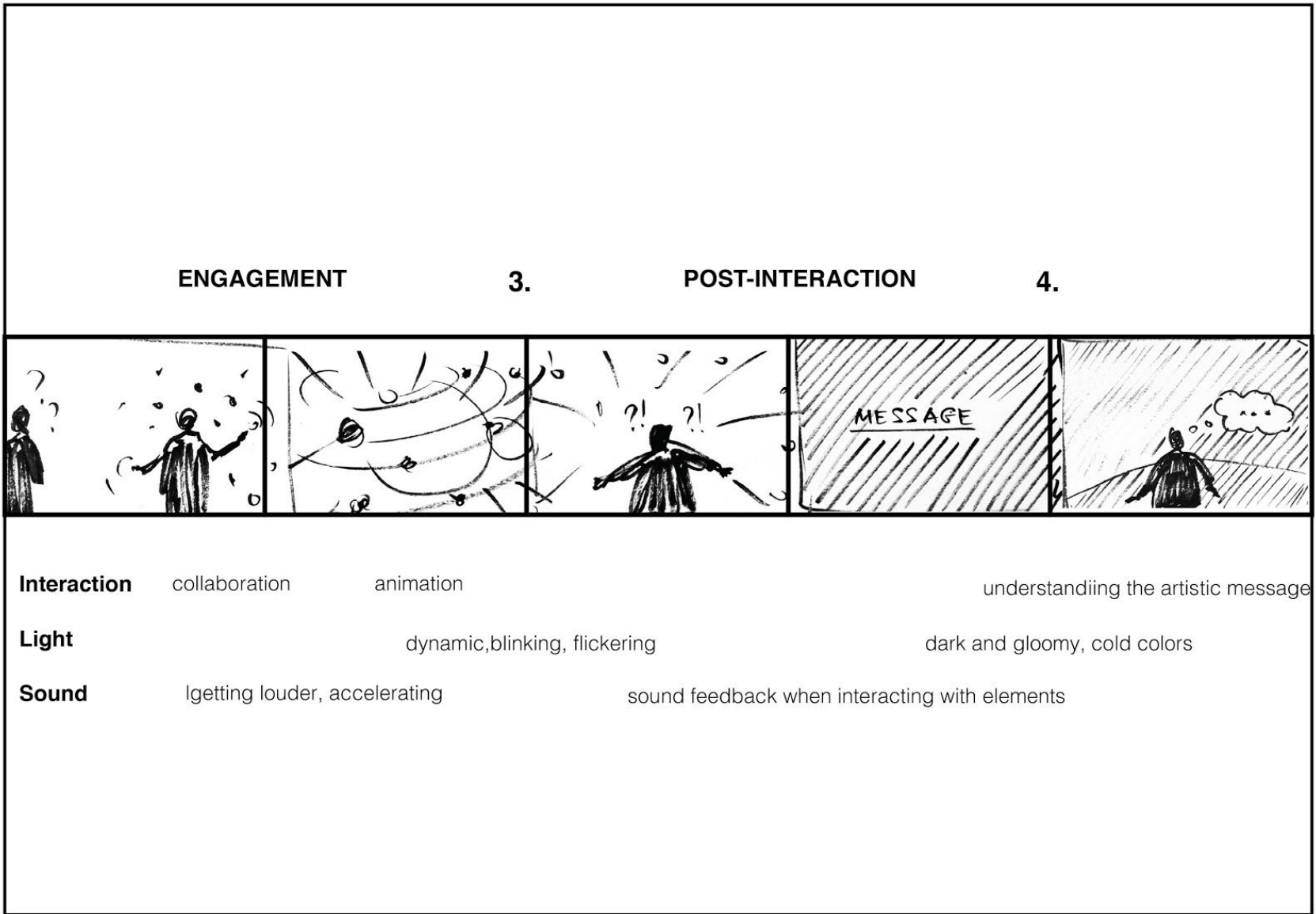
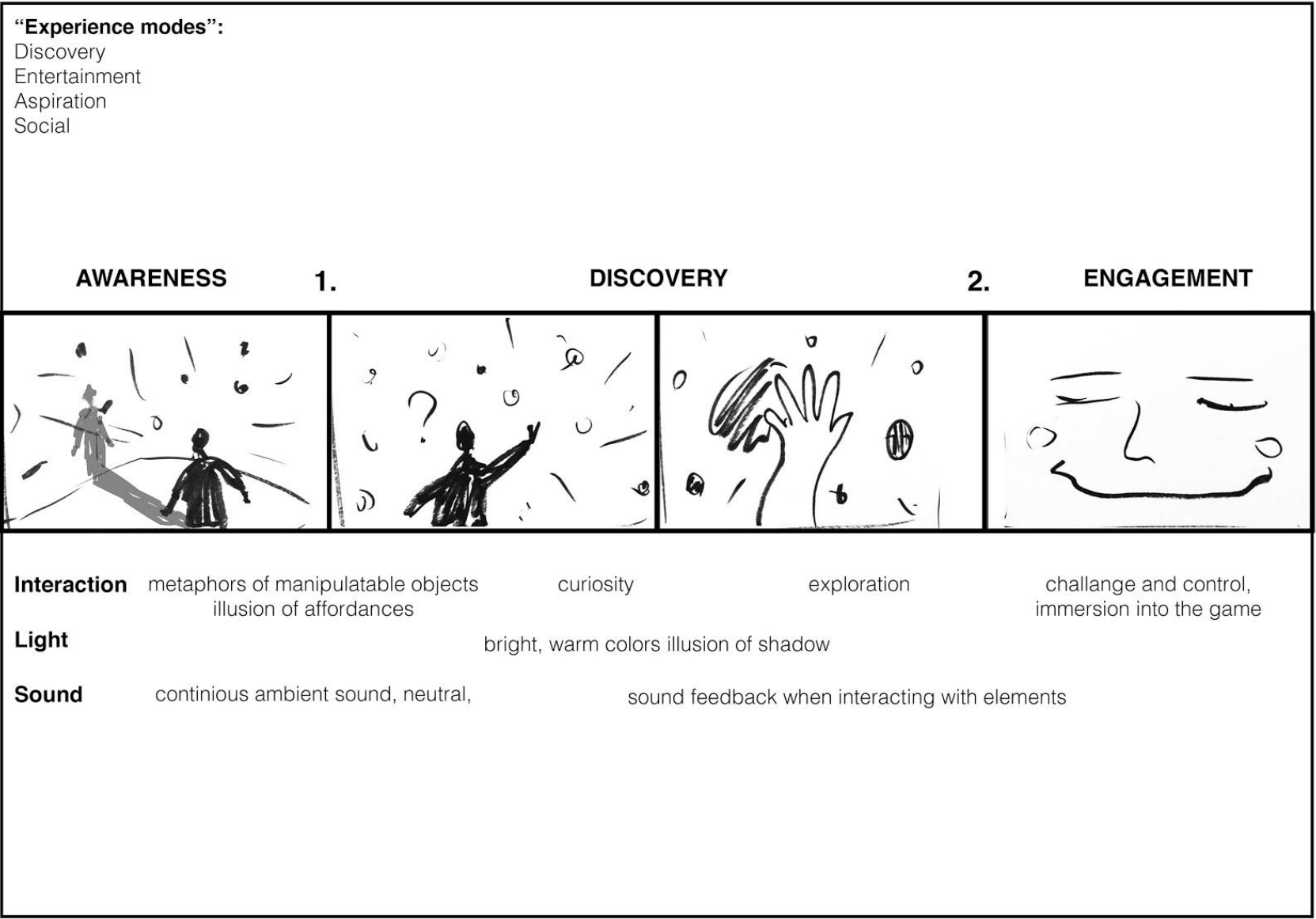


Figure 17. Spatial narrative.

Evaluation

Methods

In order to collect the data, three methods from the field of HCI were used: observations, interviews and input logging. These methods were chosen to evaluate:

- The general activity of visitors
- The behaviour response
- The emotional response
- The understanding of the artistic message

The participatory observation method was used during testing before the event with volunteers from Futurice and during the event in Amos Anderson. Unstructured interviews were conducted with a limited number of visitors attending the HFW event as well as museum visitors. The interviews were all anonymous. Each interaction was recorded and converted to a GIF animation and uploaded on a website, allowing for quantitative analyses to be conducted on the number of sessions.

Limitations

Due to the lack of framework for designing atmospheric environments and interactions with integrated technology as well as some practical limitations in the context of the HFW event, some disadvantages of the prototype study should be outlined. The primary limitation is the constraint upon engaging the entire space. Instead, the installation had a low impact on the atmosphere and served as a subtle intervention to the existing environment. Another disadvantage of the prototype is the predominance of human-computer interaction over human-space interaction. This thesis suggests that spatial interactivity does not assume a human-computer interaction. However, due to the restrictions, the interactivity had to be compressed into an interactive wall rather than an interactive space, hence the computer aspect was in the centre of people's attention.

It also worth to outline the contradiction between two ongoing events happening in the space at the same time. The ongoing exposition 'Generation 17' in the Amos Anderson museum and the HFW event happening at the same time became the reason for confusion for some visitors due to the contrast in the contexts of these two events. This issue has influenced the impact on understanding the artistic message of the installation. Moreover, this prototype study involves measuring methods that make it possible to only evaluate visitors' behaviour and emotional reactions, which might not be sufficient in order to measure visitors' perception. According

to Jelic et al. (2016), in order to investigate a person's internal states during the experience, there might be a need to also measure physiological activities (heart rate, skin conductance, etc.) in addition to behaviour and emotional response (Jelić et al., 2016). This study does not provide objective measures of body and brain activity because it falls outside the scope of this thesis. These investigations could be considered in future works.

Observations

People that came up to the attic were both HFW participants, mostly women aged 18-30 and Amos Anderson museum visitors. The motivation for the HFW participants was curiosity, since there were posters to guide the way and inform what was happening upstairs. HFW people also came to the attic in between the fashion shows, while regular museum visitors were coming throughout the day. In general, most visitors did not experience any difficulties in understanding how the interaction works as they approached the wall and could see their 'shadow'. Nevertheless, the interaction elements of the installation were not discovered by some people. Occasionally, visitors observed the projection from far away and did not approach the installation close enough to be able see the 'shadow'. This can be explained by contradiction between two ongoing events occurring at the same time in the attic. In this manner, some people might conceive the installation as another artwork that belongs to the 'Generation 17' exhibition. None of the artworks from this exhibition were interactive and represented pictures, sculptures and objects that were supposed to be observed only.

The differences in the behaviour of people from different generations could be clearly seen from the observations. Young adults and children were the most engaged and entertained participants. They were able to recognise the interaction patterns quickly and were spending more



Figure 17. Visitors in the Amos Anderson museum.

time interacting with the installation, by participating in several sessions. Conversely, elderly visitors often chose to stand and observe the projection without trying to interact. The reason for this behaviour might be the adoption of younger generations to gesture interfaces and human computer interaction.

Not every participant was eager to collaborate with others while interacting. Some people who came in couples or groups chose to engage with the installation in turns. This can indicate that people did not realise that several people could interact at the same time. Yet again, younger people could recognise the features of the prototype more easily than the elderly and were eager to collaborate. It seemed that the public nature of space played an important role in the motivation to interact and collaborate. While some people could actively experiment with different gestures, others avoided trying any gestures, changing their posture and position in the space. The interviews later revealed that some visitors did not want to express any movements because they felt that it would make them look embarrassed or funny, even though they assumed that the installation reacts to gestures. Nevertheless, in a few instances, a visitor's behaviour could motivate other visitors to join or start the interaction at a later stage. Overall, avoiding density and crowdedness might be associated with the Finnish mentality and appreciation of privacy that dictates the norms of comfort.

There was limited evidence to indicate that the installation probably evoked a sense of immersion in some people. For example, the introduced looming effect in the animation caused a bodily response, such as a postural sway. This could indicate a capacity to immersion, however the sense of presence also has to be measured by other different methodologies (Jelić et al., 2016).

The observation method became an efficient way to measure the behavioural reactions of visitors, circulation and the interactive qualities of space. In general, people were able to recognise interactive features easily and most of the time selected the right gesture to start the interaction. The installation was able to provoke curiosity and attract attention. However, in order to measure perception and experience, there was a need to explore the ways in which people understood the space and what they gained out of the engagement therewith. For this reason, unstructured interviews were conducted and analysed.

Interviews

There were several interviews that were conducted during this research: three volunteers from Futurice and HFW staff were interviewed before the actual event, while other interviewees were Amos Anderson visitors and HFW participants. The method for evaluating the mood was based on the study evaluation interactive installation, which includes requiring participants to answer questions right before the playing session and right after (Bressan et al., 2017). Several participants, mostly volunteers from Futurice, were asked to describe their mood in a few words before and after entering the space in order to measure the effect of the atmosphere on mood. This test was conducted before the HFW event and participants already had an idea of the concept of the prototype, therefore, they already had some expectations about the interaction. Some answers before the interaction were 'excited', 'cheerful', 'curious', 'interested', 'stressed'. Interestingly, the results after interacting with the prototype were contrasting: the participants who felt stressed described their mood as 'peaceful', 'slow'. The participants who expected to meet more exciting and actionable experience, used the words 'calm', 'grumpy', 'sleepy', 'depressing'. This study demonstrated the transition of visitors' mood through an intentionally designed atmosphere. However this study was conducted only during the testing session before the event. During the actual event, HFW and Amos Anderson museum visitors were asked to describe their mood only after interacting with the prototype. It was noticed that among all the interviewed HFW visitors, a significant contrast was observed between the atmosphere on the other floors (where the fashion shows took place) and the installation space. Some visitors described the atmosphere as 'mystical', 'calm', 'soothing', 'strange' and their mood as 'lazy', 'slow', 'tired'. The reason behind the similarities in the answers could be also due to the fact that the installation space was less crowded



Figure 18. Visitors in the Amos Anderson museum.

and isolated from the overwhelming atmosphere of the fashion shows.

During the interviews it was also noticed that the artistic message of the installation also played a significant role in mood changes. Some of the interview questions were structured in a way to evaluate how visitors understood the artistic message. Some of the questions were quite straightforward: ‘What do you think is the idea of this installation?’, ‘Was it a learning experience/entertainment/waste of time for you?’ The purpose was to verify visitor acceptance and overall effectiveness and to receive feedback to update the future design. During the testing sessions there was a chance to change the sound and colour settings in order to analyse the effect of these settings on an overall mood and perception of the artistic message of the users. The results demonstrated that adding some amusing, playful sounds and changing the colour of the light to bright and vivid evokes different moods and associations. The users showed more interest and emotions as well as variety in gestures and changes in their posture and position. The changes in light and colour also influenced the experience: for example, when light and sound have been changed, the users described their experience as ‘playful’, ‘entertaining’, while the original version was conceived as a ‘learning experience’, ‘informative’. During the interviews at the event, the interviewed visitors’ reactions were different. In general, people with previous knowledge about the topic (chemicals in textiles) opened a longer discussion and shared their opinions about the issue while people who were not aware of the topic (mostly non-HFW participants) understood the artistic message but were not particularly interested in the subject. For visitors who did not participate the event, the installation happened to be ‘out of the context’, ‘unrelated’ because they conceived it as a part of the ‘Generation 17’ exhibition in the museum. This example can demonstrate the importance of bearing the meaning-knowledge factor of aesthetic perception in mind while designing experience. People with different cultural backgrounds and motivations have experienced the same concept differently. Overall, according to the interviews with HFW participants, who were meant to be the target audience, the installation made people think about the topic and they predominantly described it as a ‘learning experience’.

The analysis revealed a difference between children visitors and adults. While most of the adult participants saw the installation as ‘educating’, the children audience demonstrated excitement about the gesture interactions and conceived it as a game.

Input logs

The software made for this installation logged input from the prototype and can be viewed in the table:

- Saturday total number of sessions: 33
- Sunday: 22
- Monday: 90
- Wednesday: 66

After the first few days of user behaviour observation, the major issue was related to the interactivity of the installation. Some people avoided proximity to the wall and maintained their distance, which was too big for the sensors to capture their position. As a temporary solution, it was proposed to place signifiers on the floor in order to guide the visitors. Even though this solution does not support the idea of spatial interaction and it sets the installation back to the HCI patterns rather than human-space interaction, the number of sessions had increased significantly.

Results

Effect on mood

The analysis of the interviews showcased that several words describing the mood of the participants occurred more than once: ‘calm’, ‘peaceful’ and ‘relaxing’. The differences in results before interacting with the prototype and the similarities of the results following the interaction may confirm the effect of the installation on mood. Interestingly, the users used more words to describe their mood after interacting with the prototype. The increase in the amount of words can be an indicator of a richer experience since people needed to use more adjectives in order to describe it. The participants predominantly described their mood as ‘peaceful’, ‘calm’.

Light and sound had enabled transitions in the mood of the participants. Changing the light and

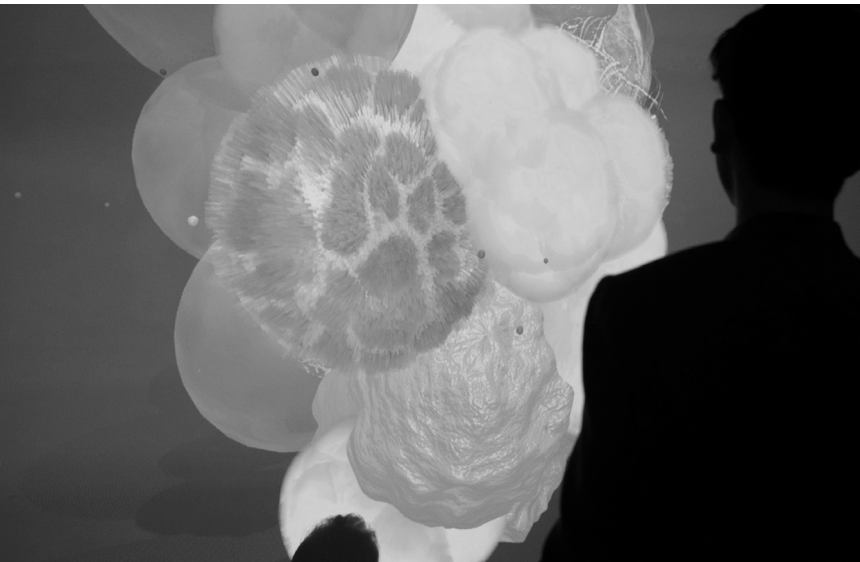


Figure 19. Visitors in the Amos Anderson museum.

sound settings also changed the way people understand the atmosphere of the environment. Light and sound settings played also an important role in understanding the artistic message of the installation.

Effect on experience

As noted in the report by Gensler (2017), 'inspirational design', a 'sense of welcome' and 'novelty' are the factors defining great spatial experience that exceeds expectations (Pittman et al., 2017a). Thus, in order to exceed visitor expectations, architectural space has to be not only welcoming, engaging, and unique but also innovative and inspiring. These factors were evaluated during the interviews and the majority of the respondents appreciated the 'innovative approach' of the design. A few respondents found the installation 'inspiring' and 'educating', and shared their thoughts or opened a conversation about the artistic message of the installation.

Technology played an important role in forming visitors' experience and adding novelty into the space. People see technology as a powerful tool for innovation. The prototype study demonstrated that visitors highly rated the technology aspect and gesture interaction of the installation. This view is supported by Gensler in the 'Experience Framework' (2017), which notes that technology has an effect on several factors associated with the visitor experience: interactions (through integrated technology) and spatial qualities (atmosphere, perceived value).

The experience was not complete in some instances due to the discoverability issue. The issue related to the discoverability of interactive features could be an outcome of several factors, such as: a) the age of the participants: the observation study demonstrated that children and young adults performed better than the elderly (see p.#); b) design-related issues: ideally, the prototype was supposed to engage the whole space, but due to limitations, it was decided to make only one wall to be interactive (see p.#); c) the nature of the public space: some people avoided any gestures in public spaces because they did not want to attract attention and felt embarrassed if their attempt to interact with the space failed (see p.#).

Overall, the most of the interviewed HFW participants described their experience as 'learning', 'educating' or 'inspiring'. However, there was no emotional connection created for non-HFW visitors, who had little or no knowledge about the topic. The installation did not meet their needs and expectations, even though they were in the

same 'discovery', 'entertainment', 'social' or 'aspiration' experience modes. Thus, the prototype design had not considered the mind-sets of all the visitors of the museum.

Effect on atmosphere

According to the concept of the atmosphere summarised previously in this thesis, the architectural atmosphere of the prototype project was significantly affected by manipulating the environmental setting (e.g. light, sound, interactivity) with the use of integrated technology and had a direct effect on emotions, mood and the experience of the visitors. However, the prototype was a spatial installation and did not span across the whole space. Thus, it existed as a very subtle intervention to the existing environment and atmosphere. In this way, the installation existed at the boundary between exhibiting itself as a part of the exhibition in the museum and generating the atmosphere in the space.

43-45

Spatial design guidelines

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Light and sound

44-45

Interactivity

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Spatial narrative

These guidelines are summarised based on the preceding research in this thesis and are meant to provide an understanding on how to use integrated technology in order to design experience for all of our senses and create meaningful atmospheres in space. The main challenge of spatial designers aiming to design experiences and atmospheres is to understand the basics of the human perception of architectural space and the way in which people understand mental content and the metaphorical qualities of space. The perception of the architectural space is mainly formed through our posture, possibilities of movement, ability of hearing, seeing and feeling the environment. Through our abilities to engage in movement, hearing, seeing and feeling we shape a subjective perspective of space in our minds by grasping its mental content and metaphorical qualities. Spatial designers can intentionally create mental content and metaphorical qualities in space by manipulating environmental elements in order to produce an atmosphere. Thus, in order to allow a certain atmosphere emerge in a built environment, there is a need to know which spatial elements should be manipulated and how.

Light and sound

Even though it is essential to focus on form, it is also important to expect more from architectural space than only its physical shape. The objective should be not be to recognise space as a material structure but also as a continuously transforming set of conditions around human perception and emotions which the designer adjusts. Light and sound are components that affect or drastically change our perception of the environment. However, many architecture schools consider these fields as ‘too technical’, and they are rarely included in the curriculum. The potentials of manipulating auditory and visual stimuli offer a new dimension toward thinking about light and sound as spatial mediums. *These potentials should be assimilated by designers in order to be able to employ the modern audio/lighting technologies and understand light and sound not through technical specification but through the way they are perceived.*

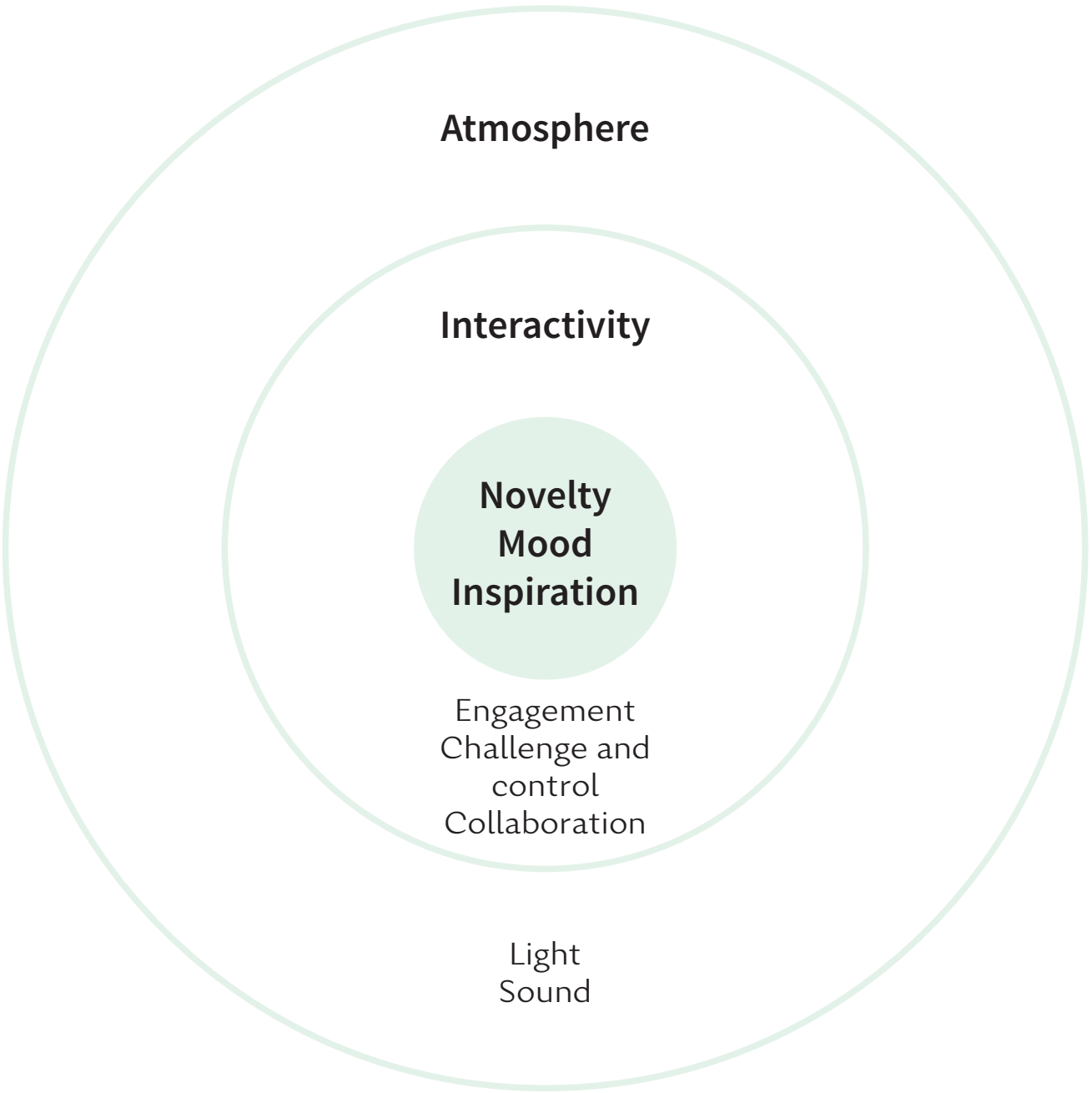


Figure 19. Impact of integrated technology on spatial experience and atmosphere. Novelty, mood and inspiration are the most important factors associated with meaningful experience in space.

Interactivity

Technologically mediated interaction in architectural space transcends the HCI paradigm toward experiences which engage the human body and capabilities for understanding and acting in space. While many findings from HCI can also apply to interaction in the architectural space, it may not be enough to create effective human-space interactions and meaningful experiences. In particular, human-space interaction should be able to provide a motivation to interact, engage and support multiple visitors at the same time. These issues need to be anticipated and understood in order to design effectively.

In order to be able to design effective interactive qualities of space, it is important to understand how people perceive architecture and what motivates people to act in space. Architectural space usually already provides affordances, suggestions to movement and objects created by mass, geometry scale and so on. Technology can radically change the appearance of affordances in space by grabbing people's attention and inviting them to interact with the media.

Attention

Attention is the important factor that should be considered while designing human-space interactions. A model of the centre and periphery of attention was proposed by Weiser and Brown (Weiser & Brown, 1997) in order to outline how much attention the computer should attract in an environment filled with ubiquitous computing technology. This model is based on the fact that visitors can monitor more things simultaneously in the periphery of their attention and suggests that ubiquitous computers should remain calm and slide effortlessly between the centre and periphery of attention. However, observations have indicated that today HCI often assumes that the user is always aware of computers. This could also be applied for interaction in the physical space, for example in interactive displays or 'digital posters'. To achieve a more immersive interaction, the computer aspect should stay in the periphery of attention. The evidence of interaction that stays in the periphery of attention can be clearly seen in the case of 'StretchCOLOR' (2017), where the primary sensory input is integrated in the tactile structure which provides affordances for a child to interact with the environment. Thus the computer is not always in the centre of her attention.

Supposing that the computer is not in the centre of visitors' attention, the challenge is to antici-

pate visitor behaviour in the interactive space. Understanding the motivation behind people's activity in space is essential in order to design a meaningful experience. There are several motivating factors for human-computer interaction outlined by Florian Alt (2013) that can be applied for spatial design.

Challenge and control

One factor is challenge and control that is based on the concept being challenged while interacting will increase the motivation to complete this task. The 'StretchCOLOR' study reveals that the motivating challenge is increasing if a clear feedback follows the child's action. According to Alt, in order to establish a challenge, the end result of interaction should not be revealed prior to being carried out and establish the sense of control there should be a freedom of choice and direct feedback provided for a user (Alt et al., 2013).

Curiosity

Another factor is curiosity. It appears through emergent stimuli that introduce something incomplete or uncertain. Curiosity can be described as a precursor to exploration. People explore the uncertainty in order to make available earlier inaccessible information (Deci, 1976). Accordingly, in order to stimulate curiosity, the interaction interactive qualities should not be too straightforward or too complex. An example of this is the water pavilion by Lars Spuybroek (2004), which uses surprising interactive elements but at the same time visitors have some initial expectations about how the interaction works.

Metaphors

Another aspect that appears to have a motivation effect is the use of metaphors. Metaphors represent images, objects or actions, which suggest resemblance of already known images, objects or situations. If interaction implies already known situations, the user perceives the interaction easier prior to actual use. The 'Create the Formula' prototype uses metaphors of manipulable objects and shadows known from real life. The 'shadows' on the wall are linked to familiar situations and it can be easily grasped, motivating people to start the interaction. There is no need to reproduce a realistic image to create a metaphor. Abstract sounds, symbols, narratives can be as effective as real-life scenarios.

Collaboration

Motivating factors in public spaces are often influenced by other people. For this reason Alt (2013) refers to collaboration as an additional element that affects motivation. The prototype study demonstrated that in some instances the motivation to interact with the installation is increased with the visibility of another visitor's behaviour. However, this motivating factor strongly depends on individual and cultural differences.

Public nature of space

One of the main issues that can prevent human-space interaction is a public nature of space. It is hard to predict how exactly people will understand the space and how they will behave because people's behaviour in space strongly depends on individual expertise, cultural background and personality traits. Thus, it is important to think about social behaviour in public space when designing interactive elements. Sociologist and writer Erving Goffman (1959) in his book 'The Presentation of Self in Everyday Life' compared social behaviour to theatrical performance. He believed that each person plays a certain role in public and always tries to maintain this role. He also argued that all players in social relations are engaged in practices to avoid being embarrassed or to embarrass others (Books & Goffman, 1959). For example, the prototype study showed that some people tried to avoid gestures because that would make them feel uncomfortable or embarrassed. Others would not start interaction in public so as not to attract attention. Similarly, Florian Alt (2013) claims that *interaction should allow people to maintain coherence of their role in the public space*.

Spatial narrative

The challenge for designers is to communicate possible ways in which users can be engaged with the environment and what kind of atmosphere it creates. In many instances, spatial narratives could be a powerful tool for imaging design intentions. By using storyboards, animations or rough prototypes to express tangible and embodied interactive qualities or visitor activities, posture and perceptions, it can be possible to set up new expectations of design for the designer. For a viewer, it helps to understand the space not only through perspective projections and elevations, but also through impression, movement and interactivity with the space. More importantly, spatial storytelling can be a first step in the transition from the depiction of form to the realm of experiencing.

Spatial narratives can also be used as a means

of communication in multidisciplinary teams or as tools to manipulate those who do not understand a highly abstract language. The need of storytelling is rarely addressed as a necessary element in the teaching of design professions and there is still a visual dominance in the ways of analysing, representing and understanding space. *The sensorimotor and mental qualities of space can be included in the representation of the design project by storyboards, sketches, models, text or oral descriptions*. It can be compared to a script for filmmaking and media arts but it is crucial to remember that the architectural space is not only observed but it is also experienced and lived.

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Conclusion

A large and growing body of literature in the fields of psychology, cognitive science, phenomenology, architecture, design and other fields has attempted to explore the way in which space affects people emotionally. It is now well established on the basis of a variety of studies that different spaces have different emotional impacts over their visitors. However, the exact ways in which the architectural space simulates different emotions are not defined yet. This thesis aimed to merge conclusions from several research fields in order to investigate the connection between human experience and space. The main focus though was concentrated on the role of integrated technology in spatial experience. One of the main purposes of this thesis was to encourage designers, architects and, perhaps, educators to conduct additional research in the field in the future because there is a clear potential to develop skills in order to design meaningful experience in space. To achieve this, the key studies on the phenomenology of architecture were analysed and the latest conclusions from neuroscientific studies on architectural experience were reviewed, yet the author uses the phenomenological approach as a main method of inquiry. For the purpose of evaluating the prototype it was decided to use some of the HCI methods, such as interviews and observations. The findings were summarised in the form of guidelines for designing technologically mediated atmospheres and experiences in the architectural space. These guidelines represent the factors that should be considered when designing technologically enhanced atmospheres and experiences in architectural spaces: light, sound and interactivity. In addition, the spatial narrative was introduced as a tool for designing immaterial qualities of space and to predict visitor experience.

Discussion

Based on the literature review, case studies and designing the prototype, this thesis demonstrated that technology can have a powerful impact on architectural atmospheres and, hence, visitor experience. The most obvious finding to emerge from the analysis is that architectural atmospheres are derived through manipulation of spatial properties such as light or sound. The methods of producing atmospheres were discussed previously (Böhme; Pallasmaa), however using technology as a method of generating atmospheres was not mentioned. New achievements in lighting and sound technology can be used as tools to enhance the environmental setting, but not as a way to change the atmosphere completely or create it from the very beginning, since it is not possible to change the material properties of space. Another important finding is that in addition to the light and sound conditions of space, it is possible to enhance visitor experience by adding interactive qualities into space. A certain atmosphere in space and interactivity can have a great impact on visitor experience. This thesis demonstrated that technology can affect some of the spatial elements that form visitor experience in space. *Light and sound are some of the elements of space that produce atmosphere and hence, affect visitors emotionally. In addition, the presence of interactivity and integrated technology in space can become a key driver of a more meaningful experience.*

This thesis summarised the spatial design guidelines for creating technologically mediated atmospheres and visitor experience in public spaces. These guidelines are meant to serve as recommendations for designers or educators who are interested in atmospheric architecture, aiming to integrate technology in public spaces or create unique experiences in space. Overall, these are only the main fundamental guidelines and more suggestions can be added in further research.

This thesis aimed to interpret the concept of atmosphere and outline the key elements of spatial experience. The need to identify and map these intangible and unseen forces that exist in the built environment emerged during the process of conducting the research. Hence, the concept of 'spatial narrative' was added to the guidelines.

Another conclusion that emerged during the process of writing this thesis is that in order to be able to design meaningful atmospheres and experiences, spatial design practice has to shift from creating form to creating experiences by appreciation of the human body with its sensory aspects as a mediator between the architectural space and the mind.

In order to develop a full picture of the impact of technology on spatial experience, additional studies will be needed. In order to examine spatial experience towards technologically mediated space versus traditional architectural space, it can be beneficial to build two environments with similar geometry but different in terms of technological integration and collect data on how differently they affect users emotionally. While the utilisation of such a method was not possible during the process of designing the prototype, this idea should be addressed in future works. Another critical issue is designing human-space interaction with the computer aspect staying in the periphery rather than in the centre of human attention. The concept of the periphery of attention by Weiser and Brown (Weiser & Brown, 1997) is described in this thesis but it was not implemented in the prototype due to its limitations.

Nevertheless, this thesis is the beginning of the expedition into the topic. The process of investigating atmospheric architecture and human perception revealed other ideas for further research. One further exploration would be merging neuroscience and architecture in order to improve the multisensorial potential of the architectural space and facilitate the understanding of the perception of space. This might open doors for different studies, such as the investigation of light mentioned in this thesis, which sought to understand the usage of this immaterial element in experience design. Another further exploration would be the use of immersive virtual reality environments to simulate and test the intended effects in relation to the sensory stimuli before implementing the design. Recent developments in VR, AR, immersive and virtual environments together with the advancement in neuroscience may help designers and researchers conduct an empirical research on the manner in which people perceive space and the way it affects people emotionally.

Light and sound are some of the elements of space that produce atmosphere and hence, affect visitors emotionally. In addition, the presence of interactivity and integrated technology in space can become a key driver of a more meaningful experience.

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Afterword

Conducting this research was both challenging and inspiring. It helped to form an understanding of the phenomenological and scientific views on the aesthetic experience in spatial design. Hence, reflecting on the experience I had conducting this research, several conclusions can be drawn:

Understanding human perception can help reveal and reinforce the mental, embodied qualities of space over materialism and commodification.

The process of exploration, analysing and experimenting led to the development of design sensibility that leads to awareness and the mapping of immaterial, invisible powers existing in the architectural space. The interpretation of these phenomenological capabilities allows a particular atmosphere to emerge inherent within the sensorial qualities of space. This approach to spatial design thinking merges the demonstration of spatial phenomena and the multisensory perception of architecture. By considering the human body with its sensory aspects as a mediator between the physical environment and the mind, the design process is no longer related to depicting objects, perspectives and forms, but rather constitutes a practice of creating spatial experience. This approach has helped to appreciate the aesthetics of dematerialisation and its role as one of the conditions that define the sensory experience of space.

Spatial design thinking and practice must evolve as the advances in digital technology are already in use, in order to enable optical and acoustic effects and surfaces for interaction. Integrated technology can have a direct impact on atmospheres in the architectural space. With the new developments in modelling, fabrication, multimedia systems, lighting and audio equipment, this can change the atmosphere significantly. Light and sound become more flexible when handled by technology rather than being manipulated through the material qualities of space; interactivity obtains a new character through sensors and the Internet of Things. Integrated technology is not an additional material for creating space but a mediator that has the potential to enhance our surroundings with the deeper atmosphere. Thus, the main task for the contemporary designer is to investigate the relationship between visitors and the space with phenomena-producing materials, such as light, colour and sound and responsive materials that interact with people.

To conclude, the process of writing this thesis opened the question about the role of architecture in a media-rich, saturated, digitalised world. As technology is invading every aspect of our lives, architectural space can adopt and become,

on the one hand, a connected, responsive place full of interactive media. On the other hand, it can become a place to escape the overwhelming, increasingly digital world and preserve its authentic qualities and materiality, thus conveying a sense of tranquillity and intimacy.

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